

WE CLAIM:

1 1. A method of machining a hollow metal workpiece
2 having a plurality of small-diameter throughgoing holes and at
3 least one large-diameter hole, the method comprising the steps
4 of:

5 picking up from a transfer station by a grab a hollow
6 workpiece and displacing the workpiece from the transfer station
7 to a machining station;

8 thereafter, while holding the workpiece in the grab,

9 a) engaging a tool from outside with a first
10 exterior surface of the workpiece and thereby
11 finishing the first exterior surface;

12 b) reorienting the workpiece by the grab and
13 engaging a tool with a second exterior
14 surface of the workpiece offset from the
15 first exterior surface and thereby finishing
16 the second exterior surface;

17 c) fitting another tool through the large-diameter
18 hole of the workpiece and positioning the
19 other tool inside the workpiece adjacent one
20 of the small-diameter holes;

21 d) coupling a drive spindle through the one small-
22 diameter hole of the workpiece with the other
23 tool and machining an inner surface of the

1 2. The machining method defined in claim 1 wherein the
2 exterior surfaces are surfaces of the small-diameter holes.

1 3. The machining method defined in claim 2 wherein the
2 surfaces of the small-diameter holes are generally cylindrical.

1 4. The machining method defined in claim 1 wherein in
2 step b) the workpiece is rotated about an axis through about 90°.

1 5. The machining method defined in claim 1, further
2 comprising the step during step d) of

3 engaging a tailstock through another of the small-
4 diameter holes with the other tool after coupling of the other
5 tool to the drive spindle to brace the other tool.

1 6. An apparatus for machining a hollow metal workpiece
2 having a plurality of small-diameter throughgoing holes and at
3 least one large-diameter hole to produce a part having a
4 plurality of finished exterior and interior surfaces, the
5 apparatus comprising:

6 means including a grab for picking up from a transfer
7 station the hollow workpiece and displacing the workpiece from
8 the transfer station to a machining station;

9 means including a tool engageable with a first exterior
10 surface of the workpiece in the grab for finishing the first
11 exterior surface;

12 drive means connected to the grab and for reorienting
13 the workpiece and engaging the tool with a second exterior
14 surface of the workpiece offset from the first exterior surface
15 and thereby finishing the second exterior surface;

16 means including for fitting another tool through the
17 large-diameter hole of the workpiece and positioning the other
18 tool inside the workpiece adjacent one of the small-diameter
19 holes;

20 means including a drive spindle engageable through the
21 one small-diameter hole of the workpiece for coupling the spindle

22 to the other tool and machining an inner surface of the workpiece
23 adjacent the one small-diameter hole with the other tool; and
24 means for displacing the workpiece from the machining
25 station back to the transfer station and releasing it from the
26 grab.

1 7. The machining apparatus defined in claim 6, further
2 comprising

3 a tailstock engageable through another of the small-
4 diameter holes with the other tool after coupling of the other
5 tool to the drive spindle to brace the other tool.

1 8. The machining apparatus defined in claim 7 wherein
2 the tailstock is displaceable parallel to a rotation axis of the
3 spindle.

1 9. The machining apparatus defined in claim 6 wherein
2 the tools are all rotatable about parallel axes, the means
3 including the grab further including:

4 a main slide displaceable perpendicular to the rotation
5 axes; and

6 a carriage displaceable on the main slide parallel to
7 the rotation axes and carrying the grab.